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ABSTRACT

The challenge today in implementing educational technology is no longer one of acquiring equipment, but rather one of improved adoption, diffusion, and use of computers. Effective implementation requires effective planning and action to ensure equity of access to resources, coordination of resources, and developing infrastructures for information sharing. One approach, the adoption model, is to spread technology thinly, introducing technology a little at a time. Another approach, the political market model, stresses the role of the school division in spurring innovation. This model often includes pilot projects to drive implementation. The concerns-based planning model assumes that technology should be implemented in an area where it provides a direct benefit based on a defined need. Planning assumptions should involve the uses of the technology, and planning guidelines defined by the National Task Force on Educational Technology specify that implementation should include a parent education component. Policy options should be spelled out in the plan, from curriculum through hardware and home and school links. Three examples of school district technology plans are provided. (SLD)

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Research Brief #11

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PLANNING FOR TECHNOLOGY INFUSION INTO THE SCHOOLS

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Technology is making significant impact on education and, in turn, school design, and hardware and software needs. A central question is how do you plan for a future where there are no guarantees about your budget, students' needs, and the kind of technology that will be available? (Brubaker, 1989)

The purpose of this research brief is to identify models, assumptions, and components that should be considered when developing a plan to infuse technology into a school or school district.

Why should we plan for technology?

According to experts in the field, acquisition of equipment is no longer the major issue confronting educators. The challenge today is improved adoption, diffusion and utilization of computers. Effective implementation of the new technologies requires effective planning and action on the part of school districts to insure equity of access to resources, coordination of resources, and developing infrastructures that allow information sharing and will alleviate disparities.

What technology related problems can a school district plan address?

A plan demonstrates each school division's approach to technology, educational policy and governance, and educational reform. The plan can be rigid, mandate-oriented, facilitative-oriented or a mixed approach.

The plan can address:

- teacher shortages, experienced in specific curriculum areas and in certain geographic regions
- disparity of student, staff and faculty access to technology and technology resources
- need for access to technology resources in every teaching and learning environment
- inability of those involved in management and support to access technology resources
- limited coordination of public and private resources
- electronically linking many public and private networks

What planning models are available to us?

No matter which overall planning structure is utilized, the process will generally use an adoption, political market place, or concern-based strategy or some combination of the three.

The Adoption Model. One approach used is **to spread technology thinly**. For example, providing an allocation formula of one computer per 50 students, or one computer for every elementary school, or setting up one computer lab in each school.

The **Natural Experiment Approach** focuses on broad diffusion and decentralized acquisitions to create an exploratory atmosphere. However, the result of spreading technology thinly is that it has no big impact anywhere, and difficulty arises in demonstrating technology's performance. This marginalization of technology generally reinforces current practice. The result is lackluster performance, which undermines public, professional and political support for the program.

The model presumes that if teachers are given access to the technologies, knowledge of how to use them, and the power to choose and develop their own tools to meet instructional objectives, the result will be school wide integration of technology in the curriculum. This integration, in turn, will enhance student's learning experiences and improve learning outcomes across grades and subjects (Stearn, 1991).

Such procedures are designed to elicit a "buy in" by teachers, which presumably encourages teachers to try the technology and upon trial, invest in its success. Unfortunately, the adoption diffusion strategies do not automatically ensure the best interests of the system.

By intent and default, the adoption model has established unfavorable ground rules and promoted territoriality. For example, in elementary schools, the libraries and media

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centers have garnered considerable control of computer resources. At junior high schools, mathematics, computer science and business departments have assumed control (Hannafin et al., 1987).

A more **pragmatic approach** is to focus resources on a few areas (i.e. training teachers, distributing hardware, supporting administrative uses of technology, evaluating software and providing distance learning).

A second approach would **focus on the student population**. This might involve using technology to further basic skills achievement in low achieving students, or providing courses to the under-served through distance education.

A third approach is the **"build the infrastructure"** approach. This approach focuses on creating an infrastructure of information highways to speed and sustain innovation and diffusion of information, and to equalize access to information resources. Once the backbone network is available, components can be added as resources are acquired.

The Political-Market Model. The political-market model stresses the role of the school division in spurring innovation and movement along the learning curve by setting standards, providing infrastructure, funding vital activities and mobilizing support for change.

The model often includes pilot projects that show clear winners and losers that can drive competition, training and build constituencies to help support the political agenda.

Political entrepreneurs, working for change and hoping to mobilize support, define programs broadly to win support (e.g., 'every school should have at least one computer').

While this strategy allows programs to be established, the programs remain without a strong continuity. The consequence has been a cycle of inadequate funding, lack of dissemination and program support, marginalization of the technology, and attenuation of public, professional and political interest in the programs. (Marshall et al., 1989).

Concerns-Based Planning Model. This model assumes that technology should be initiated in the area where it provides a direct benefit based on a defined need. Just because it can be used doesn't mean it should be, or that it provides the best solution. Finding a technological solution to meet division needs is more important than asking if the technology is state of the art. The plan should be closely aligned with the school division's strategic plan — tactical plans can be developed annually that fit the strategic direction of the organization.

What planning assumptions should we consider?

Planning for the use of technology should be focused on four key concepts that characterize the direction educational technology will be moving towards.

First, educational technology will be interactive and controlled by the learner. It will engage the student and enhance decision-making and problem-solving. These facts alone will revolutionize the classroom and the school environment.

Secondly, educational technology will make resources more accessible, changing the place of schooling, the role of the teacher and the relationship between teacher and learner. With massive data bases and visual images immediately available, the teacher will no longer be the holder and dispenser of information and the trainer of skills. Teachers will be more like coaches, mediating technology, diagnosing learning styles and proficiencies, and facilitating a variety of strategies.

Thirdly, educational technology will be affordable. It will be within reach of all learners in and outside the school.

Fourthly, educational technology will be integrated, bringing together many tools in an exciting and creative fashion. The merging of computers and video technologies with telecommunications is already in the current system (Farley, 1992).

Finally, flexibility is needed to change plans as technology changes. Emphasizing a single use could stifle much needed innovation. Initiating and experimenting with the varied capabilities of technologies are key to successful implementation (Power on!, 1988).

Are there planning guidelines that we can follow?

The National Task Force on Educational Technology (1986) recommends that school districts should do the following:

- Plan to include as line items in the regular school budget, all the costs of employing technology.
- Develop strategic plans for educational improvement that recognize the needs of a changing society and that provide for continued planning that anticipates future changes.
- Include technology as a regular budget item.
- Work with the information industry to secure favorable prices.
- Use all sources of available information to select the most useful and best technology.

- Work with parents, industry representatives, and economic development offices to secure support for adequate funding.
- Collaborate with higher education to develop programs for in-service training on the application of technology.
- Use technology in development of programs for in-service education of teachers.
- Provide leadership and support for developing the new curricula.
- Provide opportunities for parents to learn about educational technology.

What policy options could the plan include?

Curriculum. Emphasize curriculum reform with technology as an enhancement or supplement. The plan can:

- Increase student access by expanding the amount and capability of technology in schools.
- Integrate the new technology into the education process. Encourage all prospective teachers to learn about effective and emerging uses of technology in their respective curriculum areas.
- Urge all teachers to become effective users of technology. The objective is to make teachers comfortable with technology, which will affect student achievement.
- Provide access to an array of information and instructional technology devices and instructional resources for every learner, faculty, and staff member in every teaching/learning environment.
- Require the integration of technology into all new programs.
- Require that a close correlation be established between current curricular objectives and hardware applications in any proposed technology program (Marshall et al., 1989).

Personnel. Plans should consider the many types of personnel needed to support the successful implementation of technology such as mentors, technicians and credentialed library media professionals.

Professional Development and Support. Plans should provide sustained and ongoing professional development and technical support for every technology user in the teaching-learning process. Consider on-site computer coordinators who provide training and support for teachers with relevant staff development activities.

Some leading school divisions have created centers for research, development, dissemination, demonstration and evaluation of technology and software. Faculty, staff and institutions receive assistance to facilitate operations related to acquisition and purchase of educational technology tool kits at these "full-service" centers.

Distance Learning. Distance learning has become a major instructional force. Twenty-five to fifty percent of the nation's students are reached by distance learning technology.

Distance education is evident at almost every educational level in almost every sector (Ely, 1991). It is evident in nearly all plans and is used in some capacity in all states.

Distance learning provides systematic instruction for individual learners who are physically separated from their teachers.

Many distance learning programs are course-based (they offer complete courses with teacher in remote location). Some uses are supplementary classroom instruction to enrich learning (satellite teleconferences, CNN newsroom, AT&T Learning network).

Electronic Networks. Electronic networks establish and coordinate an integrated network that links schools in the district to each other and the external environment. The network can be used to 1) improve existing and establish new district-wide instructional and informational resources, 2) establish a statewide student data resource for educators and administrators and 3) establish a district-wide administrative management information resource.

Backbone Networks. Many schools create a "backbone network" that will support whatever technology they buy in the future. As needs and budgets allow, they can place technology in every room of the building. Typical network plans were estimated in 1991 at $65 to $748 per classroom. However, when a school commits to such a scheme, in a sense they are committing to a whole new approach to instruction.

Home/School Link. Learning technology can help forge new links between home, school and community. For some students, the home will be the principal place for learning. For others, the school may be more important, offering a social setting, a broad range of materials and the opportunity for interaction with others.

Regardless of where learning takes place, the home will play an important role for most students. Aided by the electronic notebook (a link to other computers) and sharing education with parents (lifetime learners), education will be

a part of life — not apart from life. For example, a recent study sponsored by Apple Computer, Inc. predicted that by the year 2000, students will be using "electronic notebooks" that will serve as a link to both home and school (Brubaker, 1989). The notebook may be used to:

- Monitor student attendance.
- Allow equal opportunity by tapping into the broad resources of the community.
- Customize schedules for every student.
- Encourage independent study, the new force for education supplemented by small and large group activities.

Facilities. The fact that telecommunication and computers are merging is putting pressure on current **facilities** and requiring design changes in new schools.

The most noticeable changes will be in the classrooms and laboratories. More space and expensive flexible equipment will be needed such as science and language laboratories and closed circuit television. There are several **key signals to planners** of educational facilities about the characteristics required for an educational environment that will be viable both now and in the future.

- Technology can help encourage the **creation of smaller schools**, with the computer and television making community resources more available to these schools.
- Within the **classrooms and laboratories**, large, thin-wall screens used to display printed text, data, maps and art, will replace chalkboards, overhead projectors, and small, bulky television screens. Labs and shops will use computer-controlled simulation to display graphic processes.
- In **administrative offices**, computer memory will replace filing cabinets.
- In the **arts**, computers, lasers, television and robotics will be part of art studios as will synthesizers in music rooms, while drama will benefit from new lighting and projection techniques.
- The **process of school planning** will be facilitated by the computer, allowing for continuous updating of total calculated areas and budgets. Computer-Aided Design (CAD) is useful for many phases of projects such as planning, design, construction documents and equipment and furnishing. A good word processor is indispensable for the preparation of specifications. The computer is also invaluable for estimating, managing construction, scheduling, coordinating equipment and tracking payment.
- The **technology of building schools**, essentially unchanged for generations, will also change. Reduction in energy costs and new construction techniques are expected impacts of technology; as are more efficient air-conditioning, lighting and heating systems (Brubaker, 1989).
- Changes in **instructional methods** can exert an important influence towards radical alteration of the traditional classroom layout. More space and flexibility are needed. The layout needs to be more diversified, with new types of furniture and large amounts of costly equipment (e.g. science laboratories, language laboratories, documentation centers, computers, audiovisual equipment, closed-circuit TV), as computer-assisted learning, group learning, peer-teaching, individual instruction and experimental science cannot make do with the classical series of identical classrooms on a corridor.

Should we renovate or build? You can assume that new and used buildings will be part of the technology facility plan. Smith (1987) says, "School districts cope with strict financial constraints; therefore, the model must use existing school structures."

Retrofits are preexisting buildings that must be assessed and refitted with appropriate cabling, conduits, outlets, etc. The process involves first determining if the current electrical power is sufficient, where to run the cabling, and where to set up wiring closets (where cables from the computer terminals meet). Then dealing with unexpected problems like asbestos removal, insufficient ventilation and underground electrical cables (Electronic Learning, 1991).

Technology Demonstration Schools. The "Model Schools" structure has been used to facilitate the development and transfer of program design for both technology and curriculum. Demonstration schools are useful to marshall all the resources for integrating technology into the daily life of a school. They should be financed under existing mechanisms, with the exception of start-up costs. All resources (equipment, curriculum, teachers, administrators, community and parental support) for integrating technology into the daily life of the school should be planned for, with the schools connected to research centers (Power on!, 1988).

Funding. Improvements to practice call for the similar infusion of funds. But many decision-makers want to be reassured that it is worth the cost to achieve in exemplary

practice, or they may continue to invest in smaller classes, systematic ongoing classes, larger salaries, fewer classes, and more planning time. Some analyses of the relative cost benefit of these factors would be helpful to inform the decision process.

Becker (1992), for example, found that successful use of computers may be costly, not only because of the direct costs of hardware and software training and human support, but also because of smaller class sizes. The trade off investments might be:

- smaller class size or providing a computer coordinator,
- staff development or more planning time,
- more software or more computers (Becker, 1992).

Cost Factors. Costs associated with technology programs include hardware, software, training curriculum, research and development, maintenance and construction costs. Cost of security, replacement and opportunity costs were not mentioned by the states surveyed.

Cost Estimation. Costs may be estimated by examining the prices of high quality equipment currently available. For example, in 1992 the cost of an IBM compatible computer with monochrome monitor, 140 megabyte hard disk drive, a modem and a printer was $_____ from vendors on a state contract. To provide one work station with this equipment for every 25 students would cost roughly $_____, not including software, furniture, local area network, staff training, etc. The same estimation can be conducted for Macintosh work stations. Costs should be calculated on a cost-per-student basis — not just total cost. A program costing $25,000 is more efficient if it serves more students.

Ongoing costs are difficult to predict since the equipment being used is new, and its useful life has yet to be established. **Cost centers** include the following: **capital costs** for hardware and equipment; **development costs** to put the system in operation; **operating costs** to run the programs; **marginal costs** of adding user sites or students; **expansion costs** to enlarge the program; **social costs** of time, energy and staff needed to implement the program.

Total costs vary a great deal. One source says that non-equipment costs such as training, maintenance and facilities sometimes amount to as much as three times the investment in equipment. Schools should not underestimate these costs. The price to be paid is underutilization and frustration with the equipment.

Replacement Cycles. School districts should plan their technology funding on a replacement cycle of no more than five to six years (Vision: Test, 1990).

Evaluating the Implementation of the Master Plan. Provide for ongoing evaluation of the extent and impact of the implementation of each recommendation of the Master Plan.

What components are found in school district plans?

Appelton School District Plan Components (WI)

- Mission
- Applicable law/regulations
- Goals
- Coordinator of Instructional Computing
- Curriculum integration
- Staff development
- Computer equipment (they specify 10 computers for every student)
- Program/Courseware/Software
- Facilities development
- Elementary and secondary standards for hardware and software
- Mobile carts
- Lab
- Fixed location
- Reader 15-20 units
- Secondary lab
- Implementation sequence

Alameda Plan Components (CA)

Goals

- Demonstrate practical knowledge of current tools of technology
- Select technology relevant to task and use it to carry out task

Teachers

- Technology at hand in classroom
- Incorporate easily into lesson plans
- Explore relevance it brings to working with students

District Future

- Daily use by making computers available in classrooms and centers
- Providing new technology for research and reporting

Community

- Make available during extended hours.

Implementation Issues (11 months to implement)

- Formalizing project goals
- Determine best technology teachers
- Renovating facilities
- Waiting for more powerful computers with more attractive power/price ratio
- Back ordering
- Installation problems
- Network creation

Equipment

- Determine # of computers
- Formula suggested (# students/5 + # of teachers = total # of computers)
- Determine specifications for computer
- Determine configuration
- Provide for maintenance
- Order computer hardware
- Design and schedule wiring
- Determine security needs
- Install computer

Northshore School District Plan (WA)

Curriculum

- Integrate into curriculum as instructional/ communication tool
- Recognize long term nature of endeavor
- Technology implementation cycle aligned in some manner with current curriculum review and adoption process

Support Systems

- Appropriate support system to maximize use of technology
- Focus implementation of plan
- CRTs at buddy level
- Security/insurance
- Take home policy
- Design or renovate to accept networking/ telecommunications
- Power supplies, space, security (Northshore, 1990)

Elements for Success of Plan

- Include entire community in process
- Complete clear, concise philosophy statement, and have well-planned and funded staff in service
- Integrate technology into curriculum
- Develop curriculum based policies for hardware/ software
- Adequately fund technical and maintenance support; ensure administrative support
- Establish policies that allow for plan modification; secure, adequate and stable funding for plan implementation (Northshore, 1990)

Pilot project

- Networking complete
- Permanent labs at elementary level to review and evaluate software
- Permanent labs at middle school level for multi-departmental use

Implementation

- Select one school to receive suggested baseline of hardware
- Select one curriculum to proceed with comprehensive review
- Select one buddy to pilot production technology

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Answers found in this research brief have been synthesized from the MERC publication listed below. To obtain a copy, please contact the MERC office.

Pisapia, J., Schlesinger, J., & Parks, A. (1993, February). Learning technologies in the classroom: Review of the literature. 213 pp. ($10.00)